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Ethnobotanical Survey and Phytochemical Analysis of Guava (*Psidium guajava* L.) Leaves in Some Communities of Mubi North, Adamawa State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author CSY design the study, perform the statistical analysis. Author ADA wrote the first draft of the manuscript. Authors TDT, DT and NNZ managed the literatures searches and edition of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

This study was carried out to determine the ethnobotany and Phytochemical constituents of *Psidium guajava* (guava) leaves in some communities of Mubi North Local Government Area of Adamawa State, Nigeria. The guava leaves were collected from Botany research garden of Adamawa State University, Mubi. The ethnobotanical survey was carried out by administering an interview using structured questionnaires to the householders of the four selected communities (Tsamiya, Gipalma, Vimtim and Muchala) of the study area. Standard procedures were used in determining the qualitative and quantitative bioactive constituents of the leaves aqueous and ethanolic extracts. The ethnobotanical survey revealed that the vegetative parts (leave, stem and root) of the plant were used for the treatment of typhoid, fever, diarrhea, malaria and some other diseases; with the leaves having highest usage with 82% and the stem and root the lowest with 4%

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each. The qualitative phytochemical analysis indicated the presence of alkaloids, tannins, saponins, glycosides, steroids, terpenoids, phenols, anthraquinones, flavonoids and phobatanins in both the aqueous and ethanolic leaves extracts. The quantitative analysis showed that the ethanolic extract had the highest content of virtually all the compounds analyzed as revealed by the qualitative screening. In conclusion, the leaves, root and stem of guava plant are used in the treatment of typhoid, malaria, diarrhea, hypertension and many other diseases by the people of Mubi North Local Government Area of Adamawa State, Nigeria with most of them (50%) using it as a remedy for typhoid and very few of them (19%) using it to treat diseases other than typhoid, malaria and dysentery. The leaf of the plant is very rich in the phytochemicals such as alkaloids, tannins, saponins, glycosides, steroids, terpenoids, phenols, anthraquinones, flavonoids and phobatanins with ethanolic extract having the highest concentration of the compounds than aqueous extract.

Keywords: Ethnobotany; leave; alkaloids; fever; Mubi.

1. INTRODUCTION

From a historical perspective, it is evident that the fascination for plants is as old as mankind itself [1]. Ethno-botany is the study of the interaction between plants and people, with a particular emphasis on traditional tribal cultures [2]. An Ethno-botanist thus strives to document the local customs involving the practical uses of local flora for many aspects of life, such as plants as medicines, foods and clothing. *P. guajava* (commonly known as Guava) is a well known tropical tree which is mainly grown for fruit. It belongs to the family Myrtaceae; Subfamily, Myrtoideae and consist of about 133 genera and more than 3,800 species. Virtually all the parts of *P. guajava* have an old history of medicinal value [3]. It is an evergreen shrub-like tree that has a wide-spreading network of branches. Mostly its branches are curved which display opposite leaves with the small petioles of about 3 to 16 cm. The leaves are wide and clear green in color and have clear and prominent veins [4]. The plant produces white flowers with incurved petals having a nice fragrant. Flowers have four to six petals and yellow colored anthers and pollination occur by insects. Guava fruit ranges from small to medium-sized with 3 to 6 cm length. It has pear like shape and yellow color in ripen condition [5]. It has a musky special odor when ripened which is strong but pleasant [6]. Its pulp is slightly darker in color which contains slightly yellowish seeds. The size of the seeds is very small and they are easily chewable. They are arranged in regular patterns; their number ranges from 112 to 535 [7].

The leaves are commonly used to prepare infusions or decoctions and these medicinal teas are used to control diabetes, gastrointestinal and inflammatory disorders, vaginal problems, rheumatism and pain, respiratory diseases, diseases caused by microorganisms, among others [8,9,10,11]. Young leaves are chewed to treat toothache and tinctures are prepared for oral use in the treatment of oral diseases [9,12]. Phytochemicals are chemicals produced by plants through primary and secondary metabolism; they generally have biological activities in the plant host and play a role in plant growth or defence against competitors, pathogens or predators [13]. Phytochemical analysis of medicinal plants has shown that numerous compounds in plant traditionally used for medicinal purpose have chemical properties effective at treating illness. Some of these phytochemicals include tannins, saponins, steroids, glycosides, anthraquinones and phenols [14]. It is well known that guava is frequently employed in numerous parts of the world for the cure of a lot of sicknesses like diarrhea, fever, dysentery, gastroenteritis, hypertension, diabetes, caries, pain relief and wounds. The use of plants as an alternative for treating illness is on the increase in the study due to lack of a functioning orthodox hospital. The purpose of this study was to undertake an ethnobotanical survey on the use of guava and to determine the phytochemicals of the plant.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out within four (4) communities of Mubi-North Local Government Area. These communities include Tsamiya, Gipalma, Vimtim and Muchala respectively. The selected communities formed the majority and were mainly farmers and traders. Mubi is a town comprising of both Mubi-North and Mubi-South Local Government Areas (L.G.As) of Adamawa

State. The town is located in the North-Eastern region of Nigeria between latitude $10^0 14^1$N and $10^0 18^1$N of the equator and longitude $13^0 14^1$E and $13^0 19^1$E. It occupies a land of about 725.85Km^2. The area has a climate with an average temperature of 32^0C and lies within the Sudan Savannah vegetation zone of Nigeria. The area has an average relative humidity ranging from 28%-45% and an annual rainfall of about 1056mm [15].

2.2 Ethnobotanical Surveys

The survey was conducted using the householders in the communities of Tsamiya, Gipalma, Vimtim and Muchalla respectively of Mubi North Local Government Area. One hundred (100) householders were randomly selected from these four communities; and were administered an oral interview using a structured questionnaire to determine their knowledge of the plant, how they use it and mode of preparation. Some of the questions administered were as follows:

- What is the common name of the plant?
- What do you use the plant for?
- What are the ailments/disease conditions which the plant can serve as a remedy?
- Which part of the plant do you mostly use?
- Is the plant used fresh or dried?
- How do you prepare it?
- Is the plant used alone or combined with other plants for curative purposes?
- Why do you prefer this plant?

2.3 Sample Preparation for Phyto-chemical Analysis

Fresh leaves of *P. gaujava* were collected and air-dried at room temperature; it was pulverized into powdered form. The ethanolic and aqueous extracts were obtained by dissolving 100 g of the dry powdered plant materials in 700 ml of 70 % ethanol and distilled water respectively. The mixtures were allowed to stand for 72 hrs during which it was intermittently shaken on a shaking orbit machine. Each mixture was filtered separately through a 0.45 pm nylon membrane filter and the extract was evaporated at 40°C by a rotary evaporator. The extracts obtained were weighed and the extractive value of each of the solvent was calculated as thus:

$$\% \text{ Extractive value of the solvent} = \frac{weight\ of\ extract}{Weight\ of\ Sample} \times 100$$

2.4 Qualitative Phytochemical Analysis

2.4.1 Test for tannins

To 1 ml of plant extract, 2 ml of 5 % ferric chloride ($FeCl_3$) was added. Formation of dark blue or greenish-black indicated the presence of tannins.

2.4.2 Test for phenols

The plant extract (0.5 g) was separately stirred with 10 ml of distilled water and then filtered. Few drops of 5 % $FeCl_3$ reagent was added to the filtrate. Blue-black or blue-green coloration or precipitation was an indication of the presence of phenols [16].

2.4.3 Test for sterols

One (1) ml of extract was treated with drops of chloroform, acetic anhydride and concentrated H_2SO_4 and observed for the formation of dark pink or red color.

2.4.4 Test for saponins

To 1 ml of plant extracts, 5-10 ml of distilled water was added and shaken in a graduated cylinder for 15 minutes. Formation of a 1cm layer of foam was an indication of the presence of saponins.

2.4.5 Test for flavonoids

To 2 ml of plant extract, 4 drops of concentrated Sulphuric acid was added. The formation of orange color indicates the presence of flavonoids [17].

2.4.6 Test for anthraquinones

About 3 ml of the aqueous extract was boiled with 3 ml of aqueous Sulphuric acid and filtered while hot. Three (3) ml of benzene was added to the filtrate and shaken. The benzene layer was separated and 3 ml of 10 % Ammonium (NH3) added. A pink, red or violet colouration in the ammonical (lower) phase indicated the presence of anthraquinone derivatives [18].

2.4.7 Test for alkaloids

To 2 ml of plant extract, 2 ml of concentrated Hydrochloric acid was added, and then 3 drops of Mayer's reagents. Presence of green color or white precipitate indicates the presence of alkaloids.

2.4.8 Test for terpenoids

About 2 ml of the organic extract was dissolved in 2 ml of chloroform and evaporated to dryness. 2 ml of concentrated Sulphuric acid was then added and heated for about 2 mins. A greyish colour indicated the presence of terpenoids [19].

2.4.9 Test for glycosides

Salkowski's test: 2 ml of each extract was dissolved in 2 ml of chloroform. About 2 ml of sulphuric acid was added carefully and shaken gently. A reddish-brown colour indicated the presence of a steroidal ring "that is aglycone portion of glycoside" [16].

2.4.10 Test for phlobatannins

About 2 ml of the extract was boiled with 1 ml of 1 % aqueous hydrochloric acid deposition of a red precipitate was taken as evidence for the presence of phlobatannins [19].

2.5 Quantitative Phytochemical Analysis

Alkaloids, tannins, saponins, glycosides, steroids, terpenoids, phenols, anthraquinones, flavonoids and phobatanins were quantitatively analysed using the method described by [19].

3. RESULTS

The result of the ethnobotanical survey indicated that about 82 % of the respondents used the leaves of the *P. guajava* for the treatment of typhoid, fever, diarrhea, malaria and other diseases; 10 % use the combination of the leaves, root and stem for the treatment of typhoid, fever, diarrhea, malaria and other illnesses while 4% either use the root or stem to treat the aforementioned illnesses (Table 1).

The study also revealed that 50, 13, 11 and 7 % of the people make use of different parts of P. *guajava* plant for the treatment of diseases such as typhoid, fever, malaria and diarrhea respectively. However, 11 % of them attested to the use of the plant as a remedy to some other sicknesses such as stomach ache, high blood pressure, yellow fever and dysentery (Fig. 1).

The qualitative phytochemical analysis of the leaves aqueous and ethanolic extracts revealed the presence of alkaloids, tannins, saponins, glycosides, steroids, phenols, anthraquinone, flavonoids and phlobatanins in both the aqueous and ethanolic extracts. The ethanolic extract showed to be more concentrated with these phytochemicals than the aqueous extract (Table 2).

The quantitative analysis of the two extracts of *P. guajava* revealed more concentration of the phytochemicals in the ethanolic extract than they were in the aqueous extract. The phytochemicals with the highest concentration were flavonoids, alkaloids and phenols. The phytochemicals with the least concentration in both aqueous and ethanolic extracts were steroids and phlobatannins (Table 3).

The quantitative phytochemical screening of the aqueous and ethanolic leaves extracts of *P. guajava* showed that the alkaloids (9.14 mg/100), tannins (4.10 mg/100), saponins (2.35 mg/100), glycosides (5.16 mg/100), terpenoids (1.62 mg/100), phenols (19.66 mg/100), anthraquinones (4.12 mg/100) and flavonoids (5.82 mg/100) contents of the ethanolic extract were significantly higher ($p<0.05$) than that of the aqueous extract. Although, the steroids (0.82 mg/100) and phlobatanins (1.23 mg/100) content of the ethanolic leaves extract were still higher, but not statistically significantly different from that of the aqueous extract (0.46 and 0.99 mg/100 respectively) (Table 3).

4. DISCUSSION

Medicinal plants have been discovered and used in traditional medicine practices since prehistoric times. Plants synthesize hundreds of chemical compounds for defence against insects, fungi and diseases. The ethnobotanical survey of *P. guajava* in the study area revealed that the plant is used in treating typhoid, malaria, fever, diarrhea, dysentery, stomach ache among others. The result agrees with findings of [8] [9] [10] and [11] who reported the use of the plant in the plant of diseases. The survey also revealed that the leaves of the plant were the most used as a result of which it constituted with about 80 %, the root 5 %, the stem 4 % and the combination of the leaves, root and stem with about 11 %. The leaves of the plant are used for curative purposes as similarly reported by [16], [20] and [9]. The survey also revealed that 50 % of the respondents used the plant to treat typhoid, 13 % fever, 11 % malaria, 7 % diarrhea and 19 % for treatments of stomach ache, high blood pressure, yellow fever and dysentery.

Table 1. Ethnobotanical Survey of the Different Parts of *P. guajava* Plant in the Four Selected Communities of Mubi North L.G.A

Plant part	Illness treated	Mode of preparation	Percentage (%)
Leaves	Typhoid Fever Malaria Diarrhoea Others	Wash then boil alone or combine with other plants for curative purposes	82
Stem	Typhoid Fever Malaria Diarrhoea Others	Wash then boil alone or combined with other plants for curative purposes	4
Root	Typhoid Fever Malaria Diarrhoea Others	Wash, crush and soak then filter before drinking or wash then boil alone or combined with other plants for curative purposes	4
Combination of leaves, stem and root	Typhoid Fever Malaria Diarrhoea Others	Wash, crush and soak then filter before drinking or wash then boil alone or combined with other plants for the curative purposes	10

Table 2. Qualitative phytochemical analysis of the *P. guajava* leaves extracts

Phytochemical	Extract	
	Aqueous	Ethanolic
Alkaloids	++	+++
Tannins	+	++
Saponins	+	++
Glycosides	+	++
Steroids	+	+
Terpenoids	+	+
Phenols	++	+++
Anthraquinones	+	++
Flavonoids	++	++
Phlobatanins	+	+

Keys: + = slightly present, ++ = moderately present, +++ = highly present

Table 3. Quantitative Phytochemical Analysis of the Aqueous and Ethanolic Leaves Extracts

Phytochemical	Extract	
	Aqueous (mg/100)	Ethanolic (mg/100)
Alkaloids	2.03 ± 0.03^{b}	9.14 ± 0.08^{a}
Tannins	1.22 ± 0.07^{b}	4.10 ± 0.06^{a}
Saponins	0.87 ± 0.13^{b}	2.35 ± 0.04^{a}
Glycosides	1.12 ± 0.07^{b}	5.16 ± 0.03^{a}
Steroids	0.46 ± 0.10^{a}	0.82 ± 0.10^{a}
Terpenoids	0.92 ± 0.04^{b}	1.62 ± 0.06^{a}
Phenols	12.46 ± 0.08^{b}	19.66 ± 0.07^{a}
Anthraquinones	0.77 ± 0.11^{b}	4.12 ± 0.04^{a}
Flavonoids	2.36 ± 0.06^{b}	5.82 ± 0.06^{a}
Phlobatanins	0.99 ± 0.08^{a}	1.23 ± 0.06^{a}

Means with the same letter along the row are not statistically different at $p<0.05$.

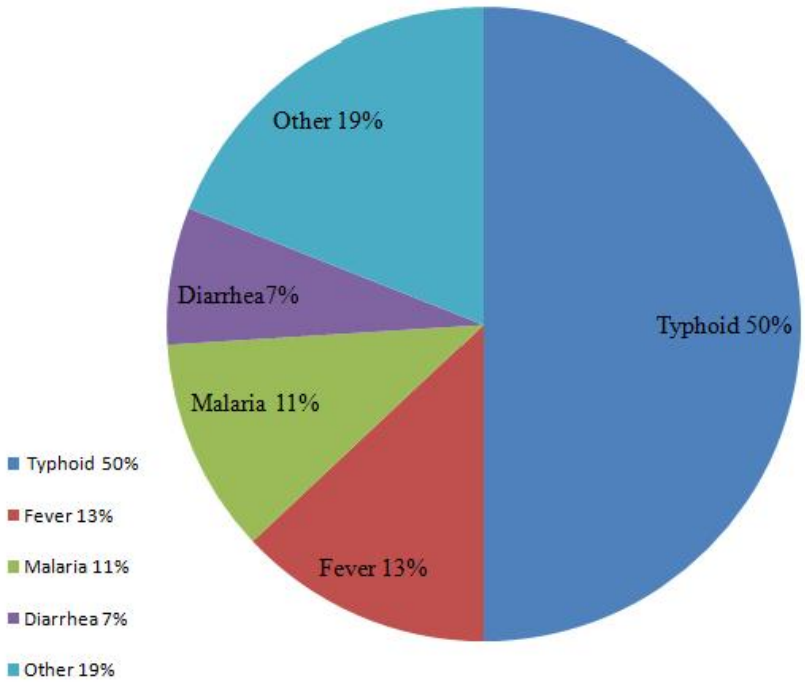

Fig. 1. Percentage of Respondents According to Disease type Using *P. guajava* plant Parts for remedy/curative purposes

The phytochemical result of this study was in line with the findings of [21] who reported the presence of some of these phytochemicals in the plant. The presence of these compounds is an indication that the plant offers medicinal benefits to its users as phytochemicals have been shown to confer protection on human health [10,11]. The quantitative analysis showed a high concentration of the chemicals such as flavonoids, alkaloids and phenols. Alkaloids have many pharmacological properties including antihypertensive and anti-malarial [22]. The presence of alkaloids in the extract might be responsible for the plant's use in the treatment of malarial infection as reported by [23]. The phenols and glycosides which were present in both the plant leave extracts as was also reported by [24] are responsible for the plants' used in the treatment of diseases like cancer, inflammation, heart disease and high blood pressure. The leaves of guava were found to be effective in the treatment of dysentery, diarrhea, typhoid, diabetes and pain relief. This was because of the presence of tannins as reported by [25]. The presence of phenol is important and dependable for anti-allergic and anti-inflammatory activities [26]; and also effective against liver damage inflammation and in serum production [27].

5. CONCLUSION

The vegetative parts (leaves, root and stem) of guava plant are used in the treatment of typhoid, malaria, diarrhea, hypertension and many other diseases by the people of Mubi North Local Government Area of Adamawa State, Nigeria with most of them (50 %) using it as a remedy for typhoid. The leaf of the plant is very rich in the phytochemicals which include: alkaloids, tannins, saponins, glycosides, steroids, terpenoids, phenols, anthraquinones, flavonoids and phobatanins. Ethanol should be preferably used as a solvent when isolating the bioactive constituents of *P. guajava* leaves.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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